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Original Article

Legibility of Handwritten Prescriptions and Risk of Medication Errors in Outpatient Care: A Cross-Sectional Evaluation Using Prescription Audit Methods

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Abstract

Handwritten prescriptions remain common in many outpatient departments, despite the increasing shift toward electronic systems. While clinicians write them routinely, their clarity and completeness vary widely, and even small inconsistencies may influence how safely medications are dispensed. This study aimed to assess the legibility of handwritten prescriptions and identify elements that may contribute to medication-related errors in a busy tertiary-care hospital. A total of 120 OPD prescriptions were collected and independently reviewed by three assessors, a junior doctor, a pharmacist, and a medical student. Each prescription was evaluated for legibility, completeness of essential components, and potential risk for misinterpretation. Data were analysed using descriptive statistics, with inter-reviewer agreement calculated through Cohen's kappa. Only about 41% of prescriptions were fully readable, while nearly half fell into a partially legible zone that required subjective interpretation. Missing information, particularly duration and strength, was common, and approximately one-third of prescriptions carried at least moderate error risk. High-risk cases were fewer but notable, typically involving both unclear handwriting and incomplete dosing instructions. These findings highlight that prescription clarity remains an overlooked but highly fixable part of outpatient care. Simple structural improvements, or gradual digitalisation, could meaningfully reduce preventable medication errors.

Keywords: Medication Errors, Prescription Writing, Outpatient Care, Drug Prescriptions, Handwriting

Introduction

Prescription writing is one of the most routine tasks in clinical practice, yet it is also one of the easiest areas for errors to slip in unnoticed.[1] Most clinicians learn how to write prescriptions early in training and continue doing so without much structured feedback afterward.[2] Over time, the process becomes quick, almost automatic, and sometimes a bit too automatic. The quality of handwriting, the completeness of essential details, and the clarity of instructions all depend heavily on individual habits, which vary widely among practitioners.[3]

Handwritten prescriptions still form the backbone of outpatient care in many hospitals in India and elsewhere.[4] Despite the growing push toward electronic prescribing systems, the reality is that many centres (especially high-volume government and teaching hospitals) continue to rely on pen-and-paper documentation simply because it is fast, familiar, and requires no setup.[5] However, with this convenience comes a predictable set of problems: illegible handwriting, missing information, confusing abbreviations, and ambiguous dosing instructions. These may seem like minor issues on the surface, but they can directly influence how medications are dispensed and, more importantly, how safely they are used.

Studies across different settings have repeatedly shown that medication errors often originate at the prescription stage, sometimes from a missing duration, sometimes from misinterpreting a poorly written drug name.[6-9] Pharmacists frequently depend on guesswork or personal experience to interpret unclear prescriptions, and patients, unfortunately, may not question what they receive.[10] The gap between what the prescriber intended and what the patient actually consumes can widen easily when the prescription itself is unclear.

Although prescription errors have been discussed widely, the specific issue of *legibility* often gets buried under broader categories of medication safety. Ironically, legibility is one of the simplest components to assess and, in many cases, one of the easiest to improve. This study focuses on evaluating the readability of handwritten outpatient prescriptions and identifying the elements most frequently associated with potential medication errors. The intention is not to criticise individual prescribers but to highlight a pattern that most clinicians already recognise in practice yet rarely quantify, from the perspective of early-career clinicians and trainees.[11]

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By examining real prescriptions collected from routine OPD settings, this study aims to provide a practical snapshot of where communication may be breaking down. Understanding these gaps is a meaningful step toward safer prescribing, whether through better writing practices, structured prescription formats, or the gradual transition toward digital systems.

Methods

This study was carried out in the outpatient departments of a tertiary-care teaching hospital over a period of 2 months. The objective was to evaluate how legible handwritten prescriptions actually are in day-to-day clinical practice and whether any elements within them might increase the risk of medication errors. We kept the design intentionally simple because the focus was more on observing a real-world habit rather than running an intervention.

Study Design and Setting

A cross-sectional, observational approach was used. Data collection happened in the general medicine, surgery, and orthopaedic OPDs, mostly because those were the departments where handwritten prescriptions were being routinely issued. No patient identifiers were recorded at any stage.

Sampling and Prescription Selection

Prescriptions were collected using a convenient sampling method. On each data-collection day, the OPD staff placed completed prescriptions in a separate folder, from which we randomly selected them later. A total of **120** prescriptions were analysed; a slightly higher number had been collected (around 135), but some were excluded because they were incomplete or the writing was smudged beyond any realistic assessment.

This was not an error in the process; it just reflected what naturally happens in a busy OPD.

Inclusion and Exclusion Criteria

We included:

- Handwritten prescriptions issued to adult patients
- OPD prescriptions only
- Prescriptions with at least one therapeutic medication mentioned

We excluded:

- Discharge summaries
- Computer-generated prescriptions
- Notes written on inpatient charts (occasionally mixed in by mistake)

Assessment Process

Each prescription was evaluated independently by three reviewers: one junior doctor, one pharmacist, and one final-year medical student who had prior exposure to prescription auditing. Reviewers were not instructed to "match" each other, they rated what they genuinely interpreted. A prescription was considered 'clearly readable' if all reviewers independently interpreted the drug name and dosing instructions without ambiguity.

The reviewers assessed prescriptions based on:

1. Legibility: Categorised as clearly **readable, partially readable, or unclear.** No special scoring software was used; it was purely human judgement, which felt more appropriate for the nature of the study.
2. Completeness of key components: Presence or absence of: Drug name, Dose, Frequency, Duration, Strength, Route of Administration (where applicable)
3. Potential risk for medication error: We categorised prescriptions into: No identifiable risk, Moderate risk (something unclear but guessable), High risk (information missing or misinterpretable)

A few **disagreements** between reviewers were expected and were resolved through discussion. *Inter-reviewer agreement (Cohen's kappa)* was calculated, although one reviewer missed marking 2–3 prescriptions, so the denominator varied slightly, minor discrepancies during data entry

Ethical Considerations

The study used anonymised prescriptions and did not involve direct patient interaction. The institutional ethics committee was informed, and a **waiver** of full review was granted since no personal health information was being analysed.

Data Analysis

Data were entered manually into an Excel sheet (one row per prescription). Statistical analysis was done using basic descriptive statistics, primarily counts and percentages. Chi-square tests were used wherever categorical comparisons made sense, though a few cells had low values, so results were interpreted cautiously.

Results

A total of **120 handwritten OPD prescriptions** were analysed. Most (about two-thirds) came from the Medicine and Surgery departments, mainly because they still rely heavily on handwritten formats. The basic findings are summarised below.

Legibility of Prescriptions: Out of the 120 prescriptions, only **49 (40.8%)** were *clearly readable* by all reviewers. A slightly higher number, **54 prescriptions (45%)**, fell into the *partially readable* category. The remaining **17 prescriptions (14.2%)** were considered *unclear*, with at least one reviewer unable to interpret the drug name or dose without guessing. A few prescriptions looked clean at first glance but ended up being ambiguous once reviewers tried to decode abbreviations. One reviewer misread "ATV" as "NTV" in two cases, which reflected how small inconsistencies in handwriting quickly become error-prone.

Completeness of Prescription Components: The presence of essential components varied widely. Drug names were almost always present, but dose and duration were the most frequently omitted. The route of administration was rarely mentioned unless it was something non-oral.(Table 1) A recurring issue was incomplete antibiotic prescribing, duration missing in almost one-third of all antibiotics noted. One prescription even had the drug written twice with different strengths; reviewers collectively flagged this as a likely oversight rather than intentional.

Table 1. Completeness of Key Components of Prescription

Component	Present (n, %)	Missing (n, %)
Drug name	118 (98.3%)	2 (1.7%)
Dose	97 (80.8%)	23 (19.2%)
Frequency	103 (85.8%)	17 (14.2%)
Duration	81 (67.5%)	39 (32.5%)
Strength	88 (73.3%)	32 (26.7%)
Route of administration	70 (58.3%)	50 (41.7%)

p-value <0.05 is significant

Potential Medication Error Risk: When prescriptions were categorised based on perceived error risk, around one-third were judged to carry at least some moderate risk. High-risk prescriptions were fewer but still notable.
High-risk prescriptions almost always had a combination of missing dose + unclear handwriting, which is the worst possible pairing. One of the reviewers mentioned that they would not have dispensed at least five of these prescriptions without reconfirming with the prescriber.

Inter-Reviewer Agreement

Cohen's kappa for overall legibility scoring was **0.71**, indicating substantial agreement. Agreement dipped slightly when rating error risk ($\kappa = 0.63$), probably because two reviewers missed marking two prescriptions each, so the denominator became uneven during calculation. We corrected for it manually, but the small mismatch still lingered.

Additional Observations (Unplanned but Noticed)

- A few prescriptions still used outdated abbreviations like "OD/BD" without context; this contributed disproportionately to disagreements.
- Two prescriptions had no patient age written, accidental omission, but interestingly, all reviewers noticed it independently.
- Around 10–12 prescriptions had handwriting that varied within the same page, likely different pens or hurried additions, which affected scoring.

Table 2. Medication Error Risk

Risk Level	Frequency	Percentage
No identifiable risk	62	51.7%
Moderate risk	41	34.2%
High risk	17	14.1%

Discussion

This study set out to examine something that is often brushed aside in the everyday rush of clinical practice, how readable our handwritten prescriptions actually are and what that means for patient safety. Although often overlooked, prescription legibility represents a modifiable component of medication safety, the findings here clearly show that it deserves more attention than it typically receives.

A little less than half of the prescriptions were fully legible, which is honestly not surprising, but still concerning. Busy OPDs, rapidly changing patient loads, and the general habit of writing in shorthand all contribute to this. The surprising part was the extent of partial legibility: almost one out of every two prescriptions had at least one area where interpretation depended on the reviewer's prior experience or guesswork. In any system that aims for safe medication practices, guesswork should ideally be zero.[12]

The incompleteness of key components, particularly dose and duration, was another recurring pattern. Duration was missing in nearly a third of prescriptions, a number high enough that it cannot be dismissed as "just occasional oversight." Missing duration is a known precursor to antibiotic misuse, and it also pushes pharmacists and patients into making their own assumptions.[13] One reviewer pointed out that they would have interpreted a missing frequency as "once daily" by default, which highlights how easily variations in personal assumptions can slip into patient care without anyone noticing. The risk classification results align naturally with these findings. Most prescriptions were safe enough, but a substantial number fell into the moderate-risk category simply because a few missing details amplified the ambiguity. The high-risk prescriptions were fewer, but their implications are heavier; these are the ones that genuinely need a second check before dispensing. In a healthcare setting that moves fast, depending on "second checks" is optimistic at best.

Inter-reviewer agreement was reasonably strong ($\kappa = 0.71$ for legibility), which reassures us that the scoring wasn't entirely subjective. There were minor inconsistencies, two reviewers forgot to score a couple of prescriptions, and which had to clean that up during data entry, but the overall agreement pattern still held. If anything, the disagreements themselves underline how easily ambiguous handwriting can lead to multiple interpretations even among trained people.

Compared with previous studies (most of which focus on prescription errors in general rather than the readability aspect alone), our findings fall somewhere in the middle. Some centres that shifted early to electronic prescribing have reported illegibility rates approaching zero[14]; others, especially government hospitals, continue to struggle with more severe levels of unreadability. This variability simply mirrors the uneven adoption of digital tools across different institutions. Our hospital still relies predominantly on handwritten notes, so the results fit that context. One interesting, unplanned observation was the inconsistent use of abbreviations. Terms like "OD" or "HS" have different meanings across countries, and sometimes even across departments. When handwriting is unclear, these abbreviations become a risk multiplier. A structured rulebook for abbreviations, even before transitioning to electronic prescriptions, might help reduce this grey zone.

Overall, the study reinforces a simple but important point: prescription writing, though routine, is not trivial.[15] It carries a direct connection to medication safety. Improving the situation does not necessarily require expensive software. Even small adjustments, structured prescription pads, mandatory fields, internal audits, and short training sessions for interns could significantly reduce ambiguity. Transition to e-prescriptions remains the ideal long-term solution, but the smaller steps are equally valuable.

This study has its limitations. The sample size was modest, and prescriptions from only a few departments were included, which may not represent the entire hospital. Some level of subjective bias in assessing legibility is inevitable, even with independent reviewers. Despite these limitations, the findings provide a realistic snapshot of what happens in a typical OPD environment and where the cracks usually form.

In essence, this study does not try to complicate the issue; it highlights a very fixable gap in our daily workflow. If handwritten prescriptions continue to remain part of our practice, and they probably will for a while, then making them clearer, more complete, and easier to interpret is one of the simplest ways to reduce preventable errors.

Conclusion

This study highlights a simple but persistent issue in outpatient care: handwritten prescriptions are often unclear, incomplete, or open to more than one interpretation. While most prescriptions were safe enough when judged collectively, the proportion that carried avoidable risk is still too high to ignore. The presence of missing doses, absent durations, and handwriting that even trained reviewers hesitated over shows how easily small habits can snowball into medication errors. The findings do not point toward a complex solution. In fact, the opposite, structured prescription formats, periodic audits, brief training for interns, and a gradual move toward electronic prescribing, are all relatively low-effort changes that could significantly improve clarity. Until full digital transitions become the norm, strengthening these simple practices is a practical and realistic step toward safer patient care. This study offers a snapshot, not a final answer, but it makes one thing clear: improving prescription legibility is one of the easiest wins the healthcare system can claim, if we decide to take it seriously.

Recommendations

- Introduce structured prescription pads with mandatory fields.
- Conduct short, periodic workshops for interns on safe prescribing habits.
- Avoid ambiguous abbreviations unless universally standardised within the institution.
- Implement routine prescription audits to maintain awareness among prescribers.
- Gradually integrate e-prescribing systems wherever feasible, even if in phased modules.

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Author's Contribution: KS contributed to data collection, preliminary assessment of prescriptions, and initial data organisation. PG assisted in data collection and supported the assessment process. KK contributed to conceptualisation of the study framework, data interpretation, and manuscript drafting and revision. JBS, AK, and KR provided academic oversight and critically reviewed the manuscript for intellectual content. All authors reviewed and approved the final version of the manuscript and agree to be accountable for all aspects of the work.

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Data Availability: Data supporting the findings of this study can be made available by the corresponding author upon reasonable request. Minor redactions may be applied to maintain confidentiality.

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